

CLAIMS

What is claimed is:

1. A variable-height thermal-interface assembly for transferring heat from a heat source to a heat sink, said assembly comprising:

a first slidable interface between two contacting surfaces, said slidable interface inclined diagonally relative to a z-axis parallel to the shortest distance between said heat source and said heat sink, said two contacting surfaces operable to slide relative to one another parallel to the direction of said incline to provide z-axis expansion of said thermal interface assembly;

a spring clip mechanically spring loading said slidable interface, said spring clip operable when released to apply a shear force across said slidable interface, said shear force causing said two contacting surfaces to slide relative to one another, coupling said sliding to provide said z-axis expansion; and

a reversible locking device, operable when in a locked condition to prevent said two contacting surfaces from sliding relative to one another, such that said spring clip remains retracted, and operable when in an unlocked condition to allow said two contacting surfaces to slide relative to one another, such that said spring clip is released.

2. The assembly of claim 1 wherein:

said first slidable interface comprises a first uniaxial rotary cylindrical joint comprising a first cylindrically concave surface in slidable contact with a first cylindrically convex surface, said first cylindrically concave surface and said first cylindrically convex surface having a common first radius of curvature relative to a common first cylinder axis;

said first cylindrically concave surface operable to rotate about said common first cylinder axis relative to said first cylindrically convex surface to compensate for uniaxial angular misalignment between said heat source and said heat sink.

3. The assembly of claim 1 wherein said spring clip is shaped approximating a deformed rectangular frame, comprising:

a first side and a second side opposite said first side, wherein said first and second sides are bent inward toward one another;

said first side operable to couple a compressive force substantially parallel to said first cylindrically concave surface; and

said second side operable to couple an oppositely directed compressive force to said first cylindrically convex surface.

4. The assembly of claim 2, further comprising:

a second uniaxial rotary cylindrical joint comprising a second cylindrically concave surface in slidable contact with a second cylindrically convex surface, said second cylindrically concave surface and said second cylindrically convex surface having a common second radius of curvature relative to a common second cylinder axis;

said second cylindrically concave surface operable to rotate about said common second cylinder axis relative to said second cylindrically convex surface to compensate for uniaxial angular misalignment between said heat source and said heat sink.

5. The assembly of claim 4 wherein:

the orientation about said z-axis of said common first cylinder axis is different relative to the orientation of said common second cylinder axis about said z-axis; and

said first and said second uniaxial rotary cylindrical joints are operable to rotate cooperatively to compensate for biaxial angular misalignment between said heat source and said heat sink.

6. The assembly of claim 4 wherein:

said common first cylinder axis and said common second cylinder axis are each inclined diagonally relative to the z-axis parallel to the shortest distance between said heat source and said heat sink; and

said first and said second uniaxial rotary cylindrical joints are each operable to slide linearly to provide combined z-axis expansion of said variable height thermal interface assembly equivalent to the sum of the z-axis expansions of said individual first and second uniaxial rotary cylindrical joints.

7. The assembly of claim 1 wherein said first slidable interface comprises a wedge interface having a first planar surface in slidable contact with a second planar surface, said slidably contacting planar surfaces inclined diagonally relative to the z-axis parallel to the shortest distance between said heat source and said heat sink, said wedge interface operable to provide z-axis expansion of said variable height thermal interface assembly.

8. The assembly of claim 1 further comprising a multi-axis rotary spherical joint operable to compensate for multi-axis angular misalignment between said heat source and said heat sink.

9. The assembly of claim 1 further comprising a shim operable to provide z-axis expansion of said variable height thermal interface assembly.

10. The assembly of claim 1 further comprising a conformal thermal-interface material applied to interface surfaces within said thermal interface assembly.

11. The assembly of claim 1 wherein said contacting surfaces consist substantially of high thermal conductivity solid materials.

12. The assembly of claim 1 wherein said reversible locking device comprises a locking pin insertable into and withdrawable from a series of through holes formed through said two contacting surfaces, said through holes in alignment with one another when said two contacting surfaces are retracted relative to one another.

13. The assembly of claim 12 wherein said reversible locking device comprises a plurality of said locking pins insertable into and withdrawable from a plurality of series of said aligned through holes formed through said two contacting surfaces.

14. The assembly of claim 12 wherein said locking pin is operable to prevent completion of installation of said thermal interface assembly while said locking pin is inserted.

15. The assembly of claim 14 wherein said inserted locking pin is elongated and protrudes relative to said assembly, such that said elongated locking pin prevents installation of a heat sink.

16. A method of installing a variable-height thermal-interface assembly for transferring heat from a heat source to a heat sink, said method comprising:

providing a first slidable interface between two contacting surfaces, said slidable interface inclined diagonally relative to a z-axis parallel to the shortest distance between said heat source and said heat sink, said two contacting surfaces operable to slide relative to one another parallel to the direction of said incline to provide z-axis expansion of said thermal interface assembly;

spring loading said slidable interface using a spring clip to apply a shear force across said slidable interface;

retracting said spring-loaded slidable interface to its most retracted condition;

locking said retracted spring-loaded slidable interface reversibly in its most retracted condition;

installing said reversibly locked retracted spring-loaded slidable interface relative to said heat source; and

unlocking said reversibly locked retracted spring-loaded slidable interface, releasing said spring-loaded shear force, causing said two contacting surfaces to slide relative to one another, coupling said sliding to provide z-axis expansion of said thermal interface assembly.

17. The method of claim 16 wherein:

said first slidable interface comprises a first uniaxial rotary cylindrical joint comprising a first cylindrically concave surface in slidable contact with a first cylindrically convex surface, said first cylindrically concave surface and said first cylindrically convex surface having a common first radius of curvature relative to a common first cylinder axis;

said first cylindrically concave surface operable to rotate about said common first cylinder axis relative to said first cylindrically convex surface to compensate for uniaxial angular misalignment between said heat source and said heat sink.

18. The method of claim 16 wherein said spring clip is shaped approximating a deformed rectangular frame, comprising:

a first side and a second side opposite said first side, wherein said first and second sides are bent inward toward one another;

said first side operable to couple a compressive force substantially parallel to said first cylindrically concave surface; and

said second side operable to couple an oppositely directed compressive force to said first cylindrically convex surface.

19. The method of claim 17 further comprising:

a second uniaxial rotary cylindrical joint comprising a second cylindrically concave surface in slidable contact with a second cylindrically convex surface, said second cylindrically concave surface and said second cylindrically convex surface having a common second radius of curvature relative to a common second cylinder axis;

said second cylindrically concave surface operable to rotate about said common second cylinder axis relative to said second cylindrically convex surface to compensate for uniaxial angular misalignment between said heat source and said heat sink.

20. The method of claim 19 wherein:

the orientation about said z-axis of said common first cylinder axis is different relative to the orientation of said common second cylinder axis about said z-axis; and

said first and said second uniaxial rotary cylindrical joints are operable to rotate cooperatively to compensate for biaxial angular misalignment between said heat source and said heat sink.

21. The method of claim 19 wherein:

said common first cylinder axis and said common second cylinder axis are each inclined diagonally relative to the z-axis parallel to the shortest distance between said heat source and said heat sink; and

said first and said second uniaxial rotary cylindrical joints are each operable to slide linearly to provide combined z-axis expansion of said variable height thermal interface assembly equivalent to the sum of the z-axis expansions of said individual first and second uniaxial rotary cylindrical joints.

22. The method of claim 16 wherein said first slidable interface comprises a wedge interface having a first planar surface in slidable contact with a second planar surface, said slidably contacting planar surfaces inclined diagonally relative to the z-axis parallel to the shortest distance between said heat source and said heat sink, said wedge interface operable to provide z-axis expansion of said variable height thermal interface assembly.

23. The method of claim 16 further comprising providing a multi-axis rotary spherical joint operable to compensate for multi-axis angular misalignment between said heat source and said heat sink.

24. The method of claim 16 further comprising providing a shim operable to provide z-axis expansion of said variable height thermal interface assembly.

25. The method of claim 16 further comprising applying a conformal thermal-interface material to interface surfaces within said thermal interface assembly.

26. The method of claim 16 wherein said locking comprises inserting a locking pin into a series of through holes formed through said two contacting surfaces, said through holes in alignment with one another when said two contacting surfaces are retracted relative to one another against said spring loading.

27. The method of claim 26 wherein said locking comprises inserting a plurality of said locking pins into a plurality of said series of said aligned through holes formed through said two contacting surfaces.

28. The method of claim 26 wherein said unlocking comprises withdrawing said locking pin from said series of through holes formed through said two contacting surfaces, causing the releasing of said spring-loaded shear force.

29. The method of claim 26 wherein:
said locking pin while inserted prevents completion of installation of said thermal interface assembly; and
said locking pin when withdrawn allows completion of installation of said thermal interface assembly.

30. The method of claim 29 wherein said inserted locking pin is elongated and protrudes relative to said thermal interface assembly, such that said elongated locking pin prevents installation of said thermal interface assembly to a heat sink.

31. A variable-height thermal-interface assembly for transferring heat from a heat source to a heat sink, said assembly comprising:

a first slidable interface between two contacting surfaces, said slidable interface inclined diagonally relative to a z-axis parallel to the shortest distance between said heat source and said heat sink, said two contacting surfaces operable to slide relative to one another parallel to the direction of said incline to provide z-axis expansion of said thermal interface assembly; and

a reversible locking device comprising a locking cam mechanism, said locking cam mechanism operable when released to cause said relative sliding motion of said two contacting surfaces and operable when locked to apply spring loading across said slidable interface.

32. The assembly of claim 31 wherein said reversible locking device comprises a handle element extending radially from a camshaft rotation axis at a proximal end and terminating at a distal end in a hook, said hook operable to lock said locking device and to provide said spring loading when locked.